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(54) **IMPELLER**

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F01D 5/02 (2006.01)
F04D 29/18 (2006.01)

(52) **U.S. Cl.**
CPC .. ***F01D 5/02*** (2013.01); ***F01D 5/14*** (2013.01); ***F04D 29/188*** (2013.01); *F05D 2260/96* (2013.01); *F05D 2210/33* (2013.01)

(58) **Field of Classification Search**
CPC F01D 5/02; F01D 5/14; F04D 29/188; F05D 2210/33; F05D 2260/96
USPC .... 415/55.1–55.7, 98, 119; 416/175, 182, 416/193 R, 198 R, 200 R, 201 R, 201 A, 203, 416/223 R
See application file for complete search history.

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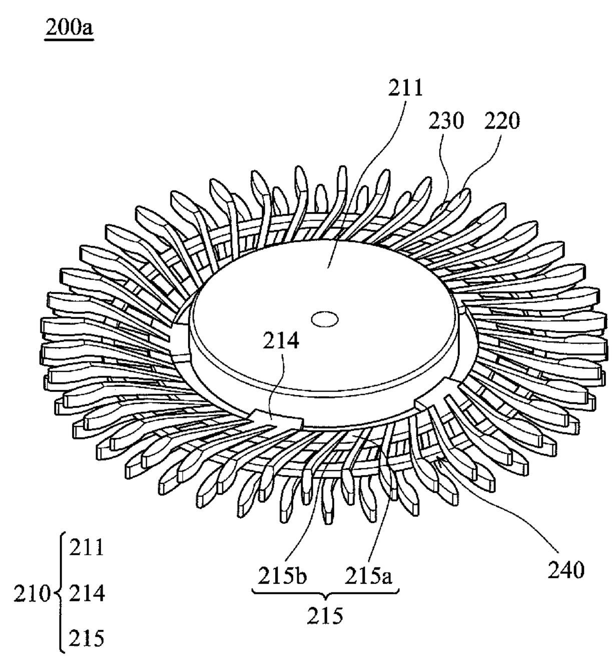
(57) **ABSTRACT**

An impeller is provided. The impeller includes a hub, a plurality of upper blades, and a plurality of lower blades. The hub has an upper surface and a lower surface. The upper blades are disposed around the hub and connect to the upper surface. The lower blades are disposed around the hub and connect to the lower surface. The upper and lower blades are alternately disposed and outwardly extend from the hub.

25 Claims, 13 Drawing Sheets



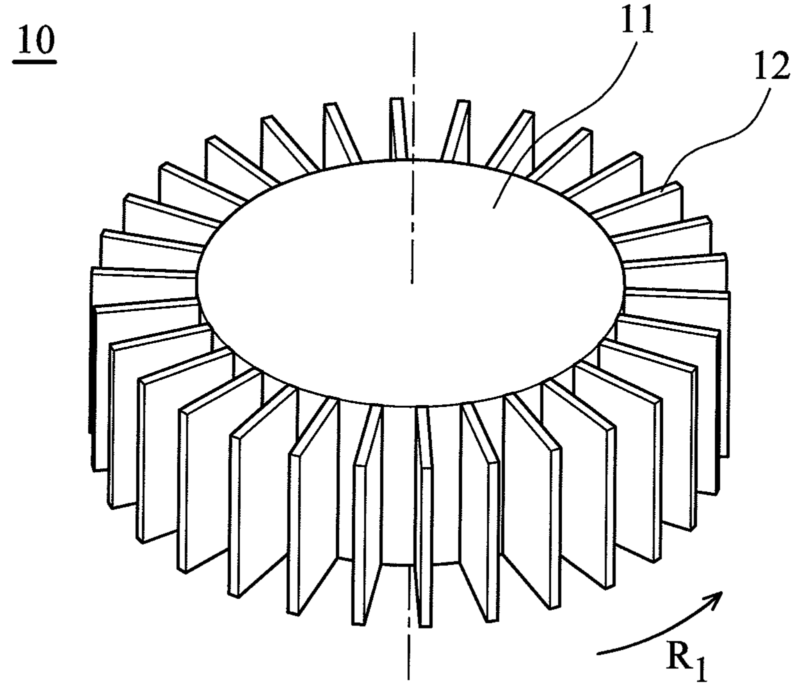


FIG. 1

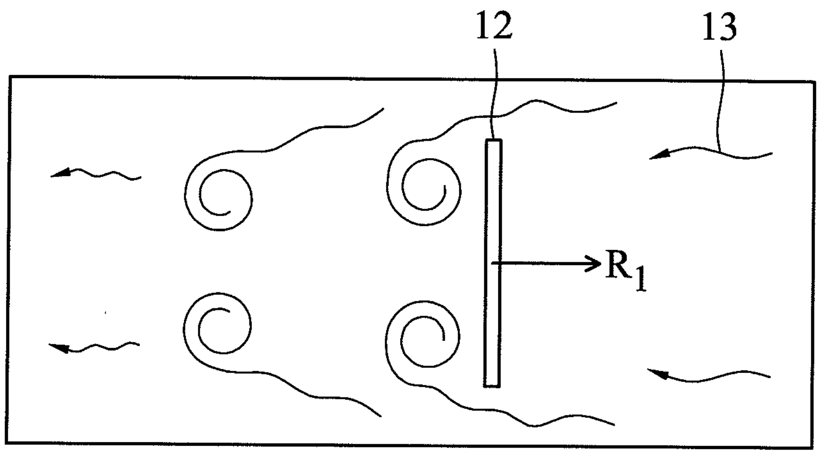


FIG. 2

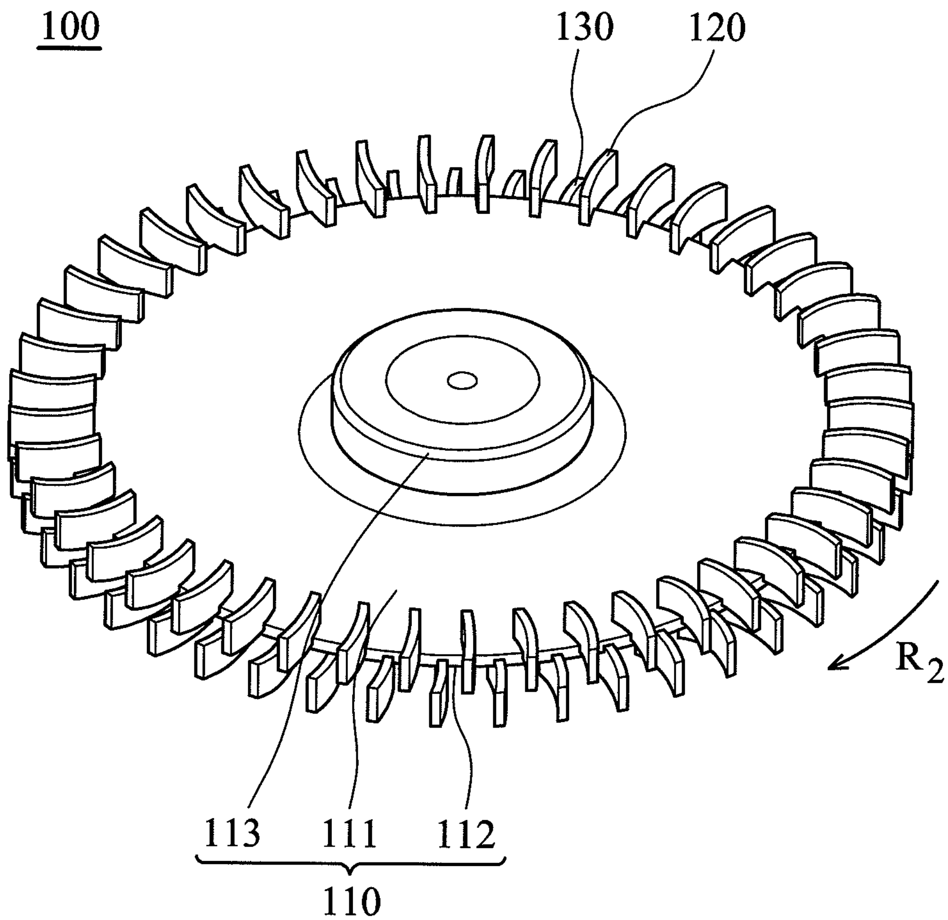


FIG. 3A

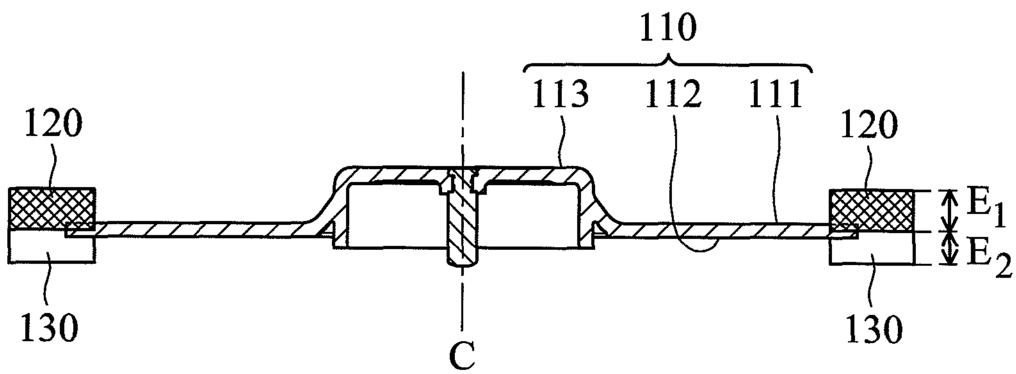


FIG. 3B

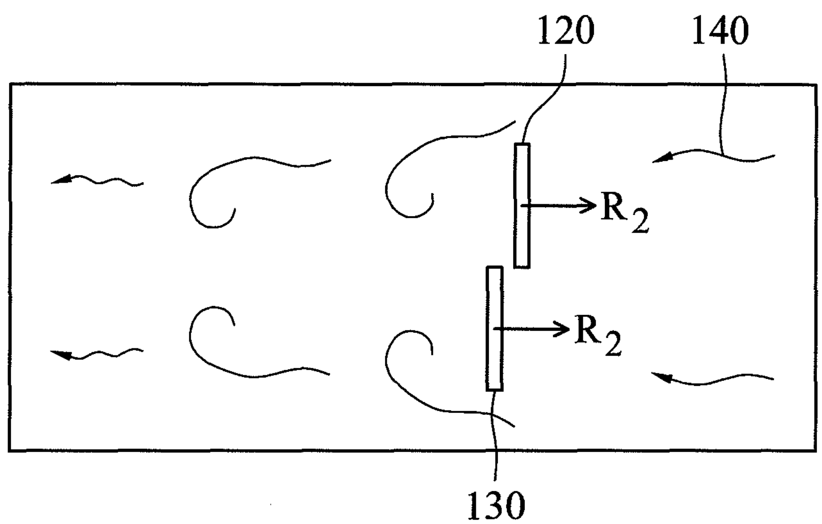


FIG. 3C

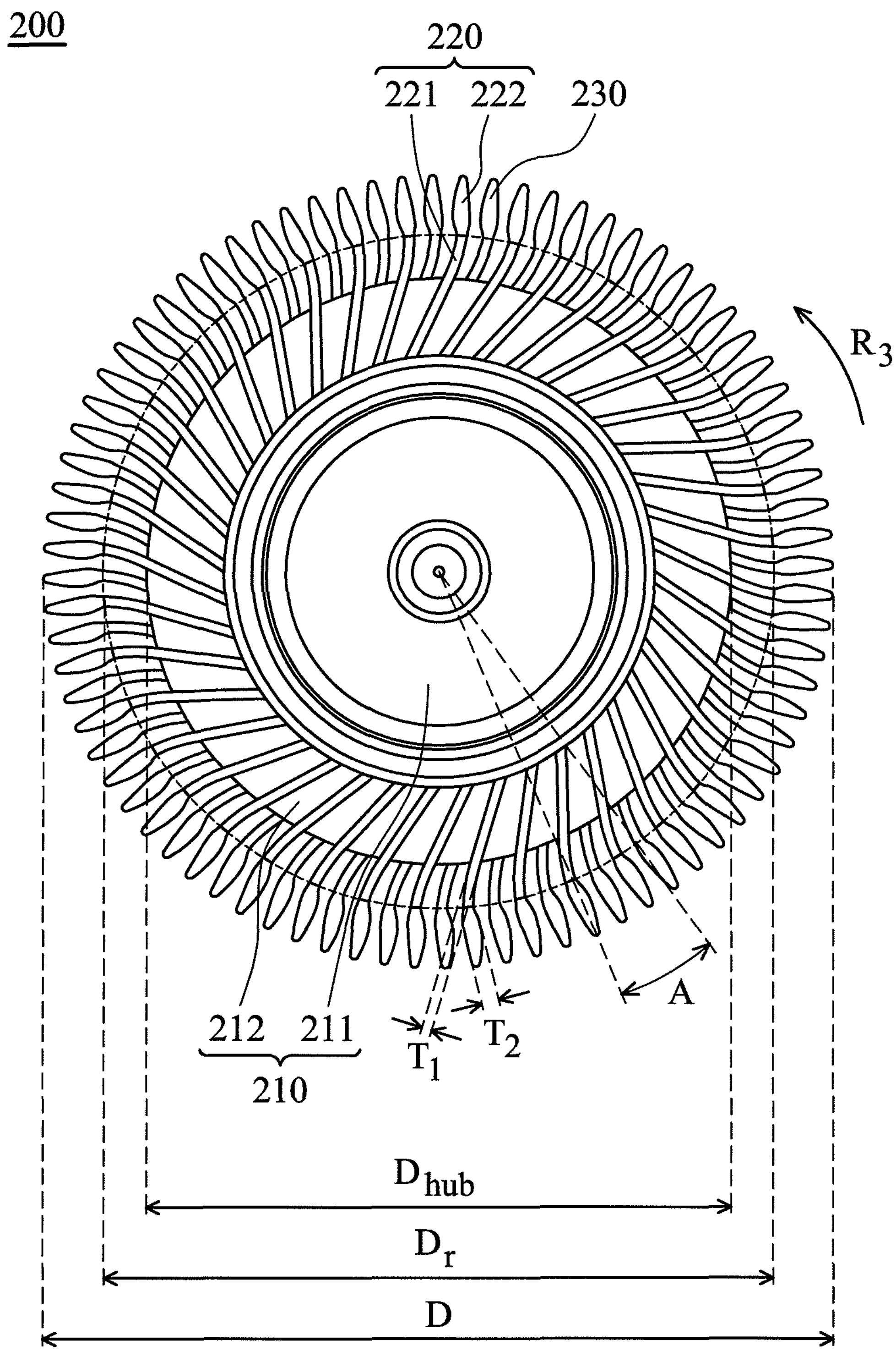


FIG. 4A

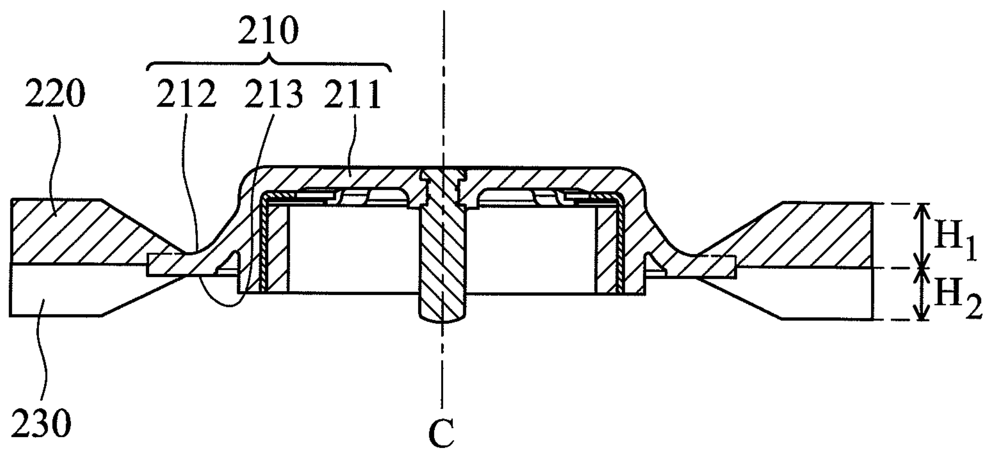


FIG. 4B

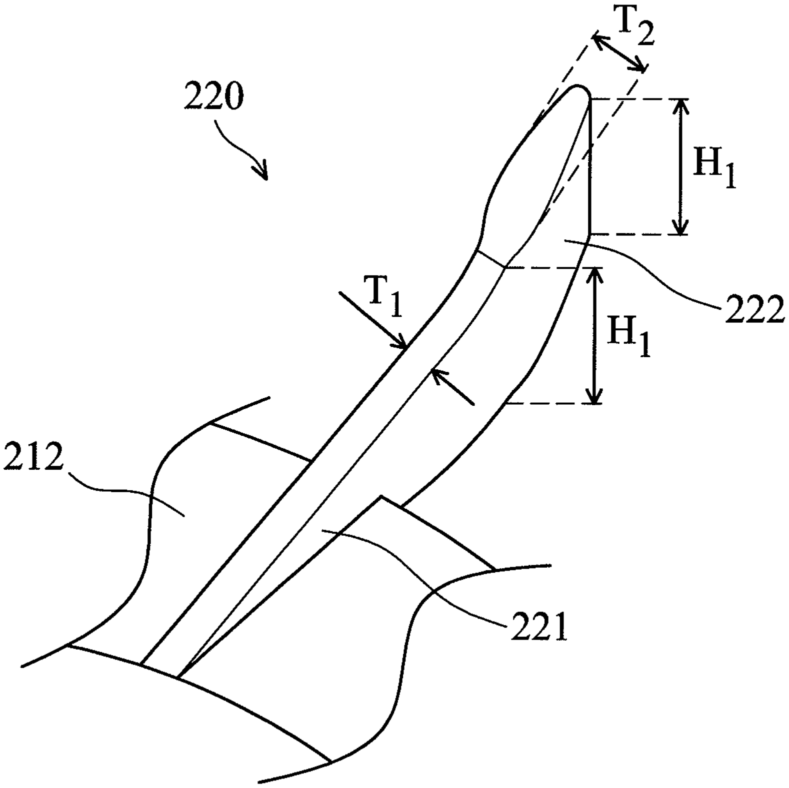


FIG. 4C

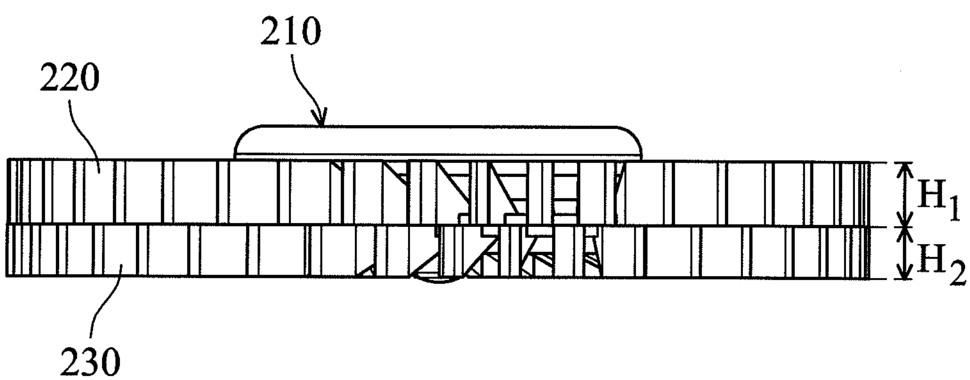


FIG. 4D

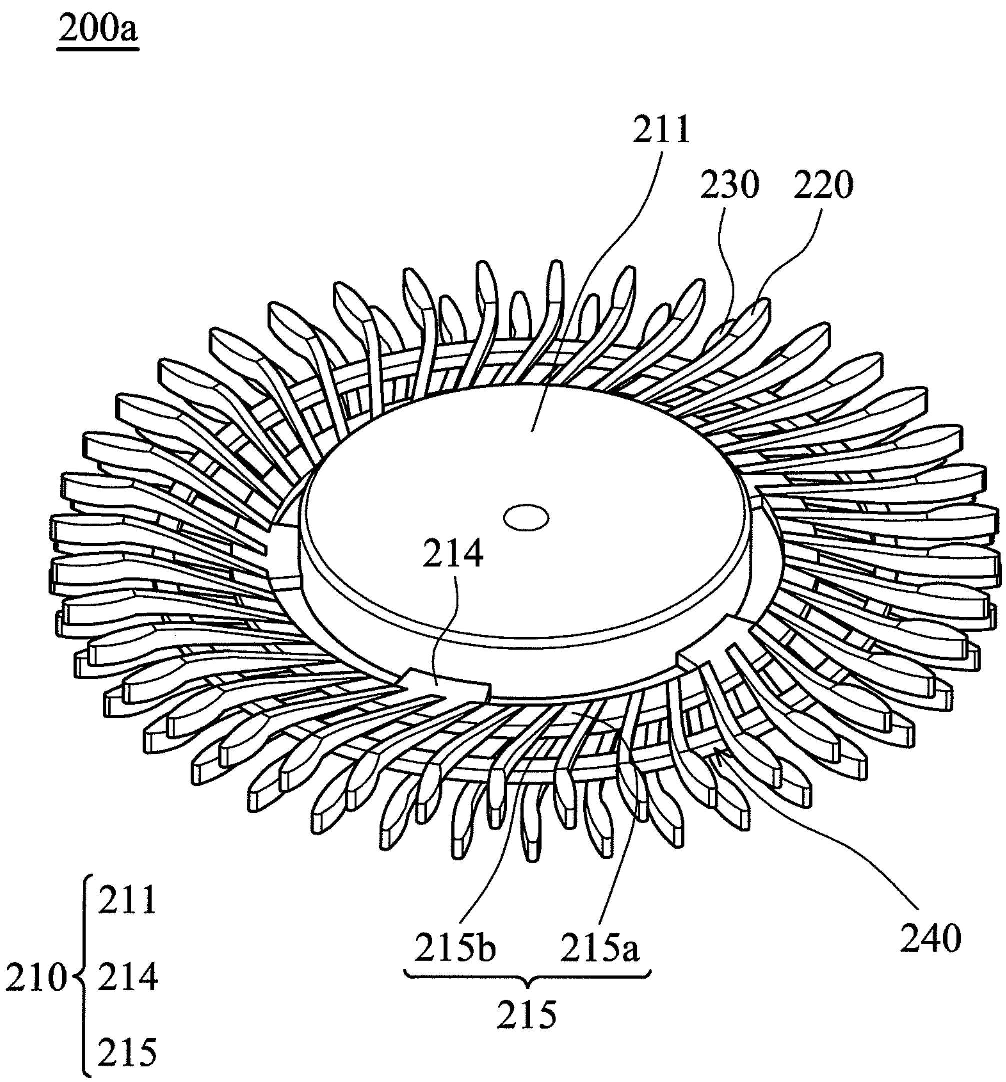


FIG. 5

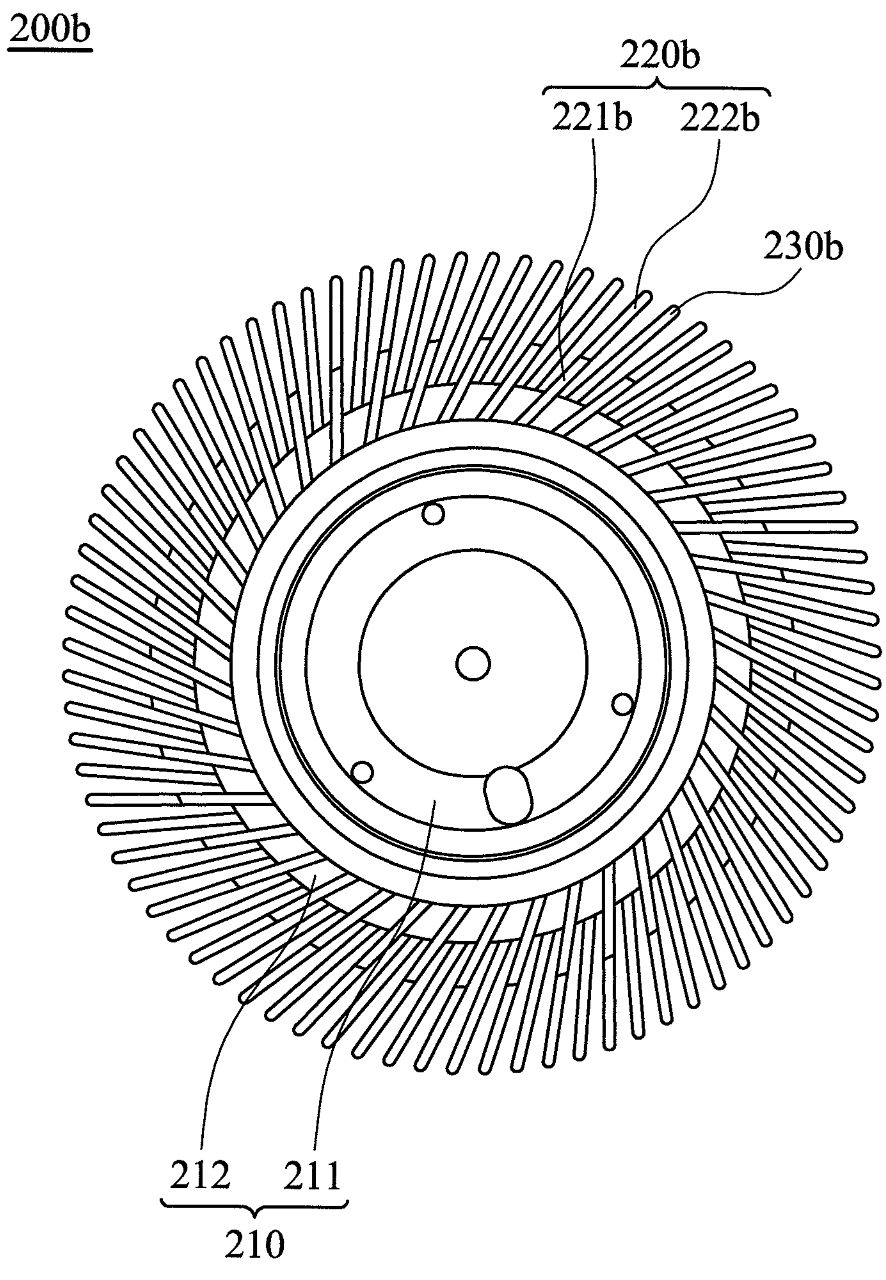


FIG. 6A

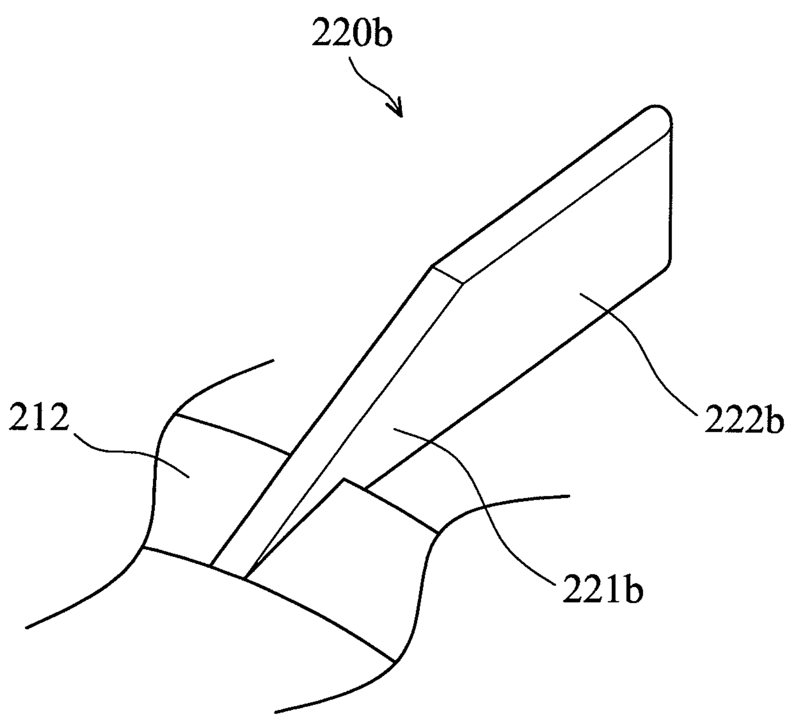


FIG. 6B

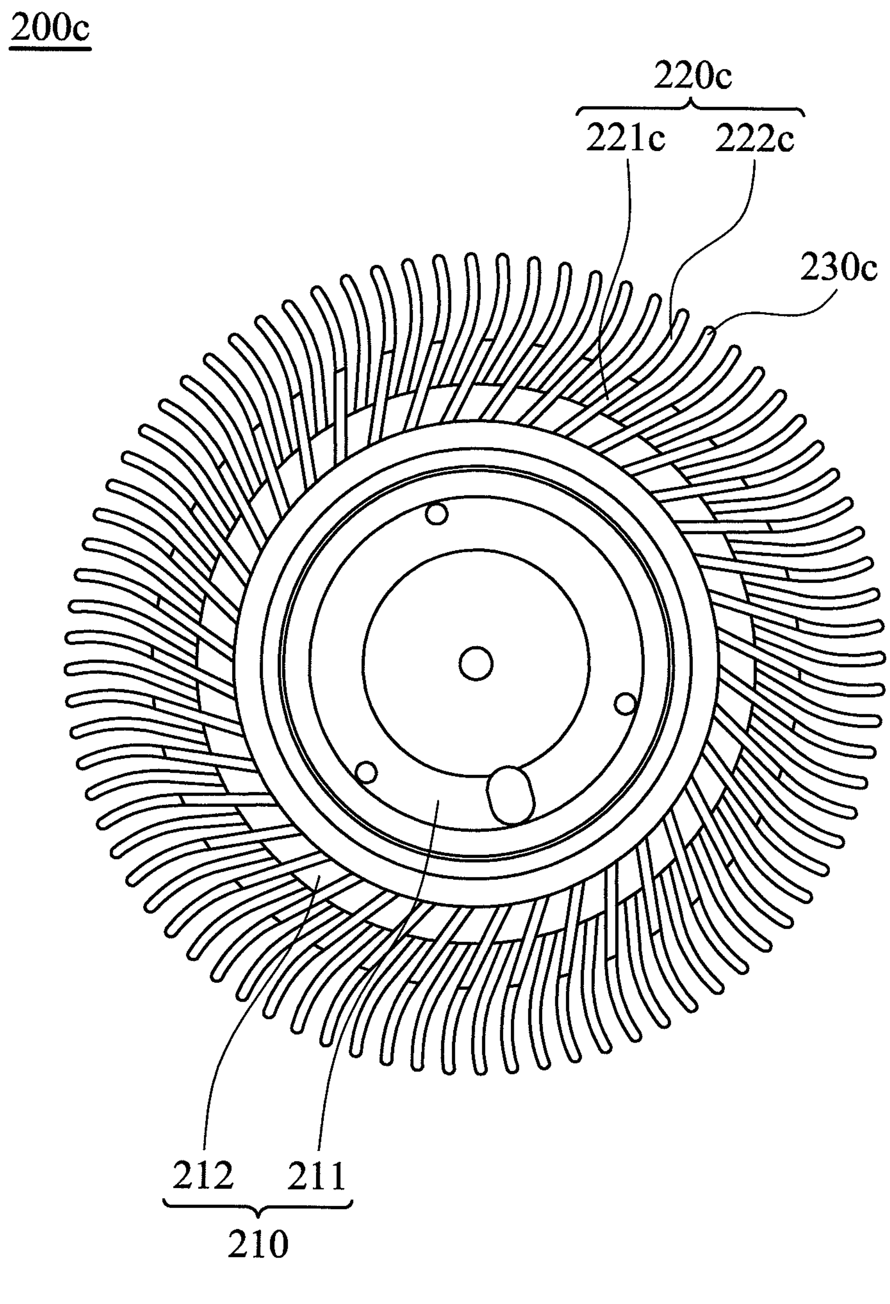


FIG. 7A

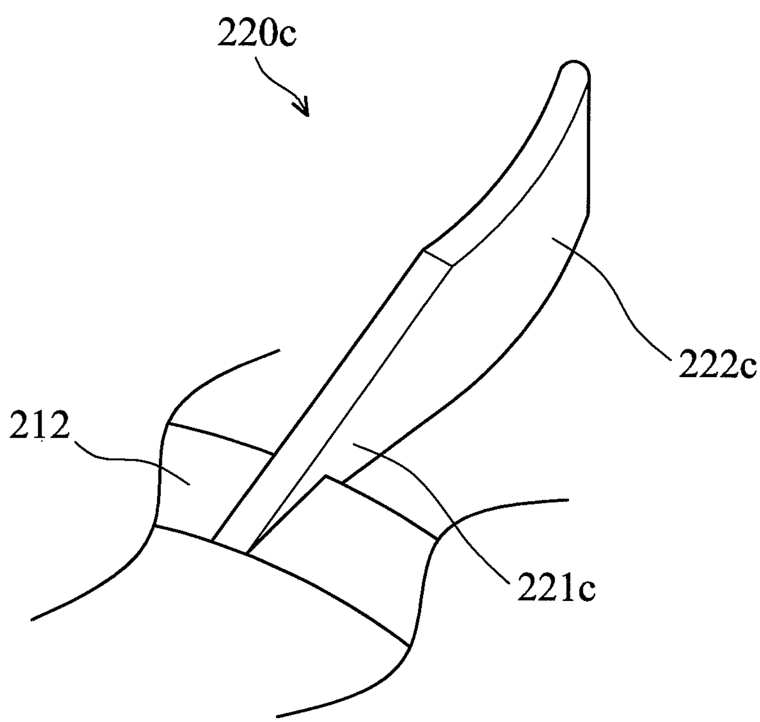


FIG. 7B

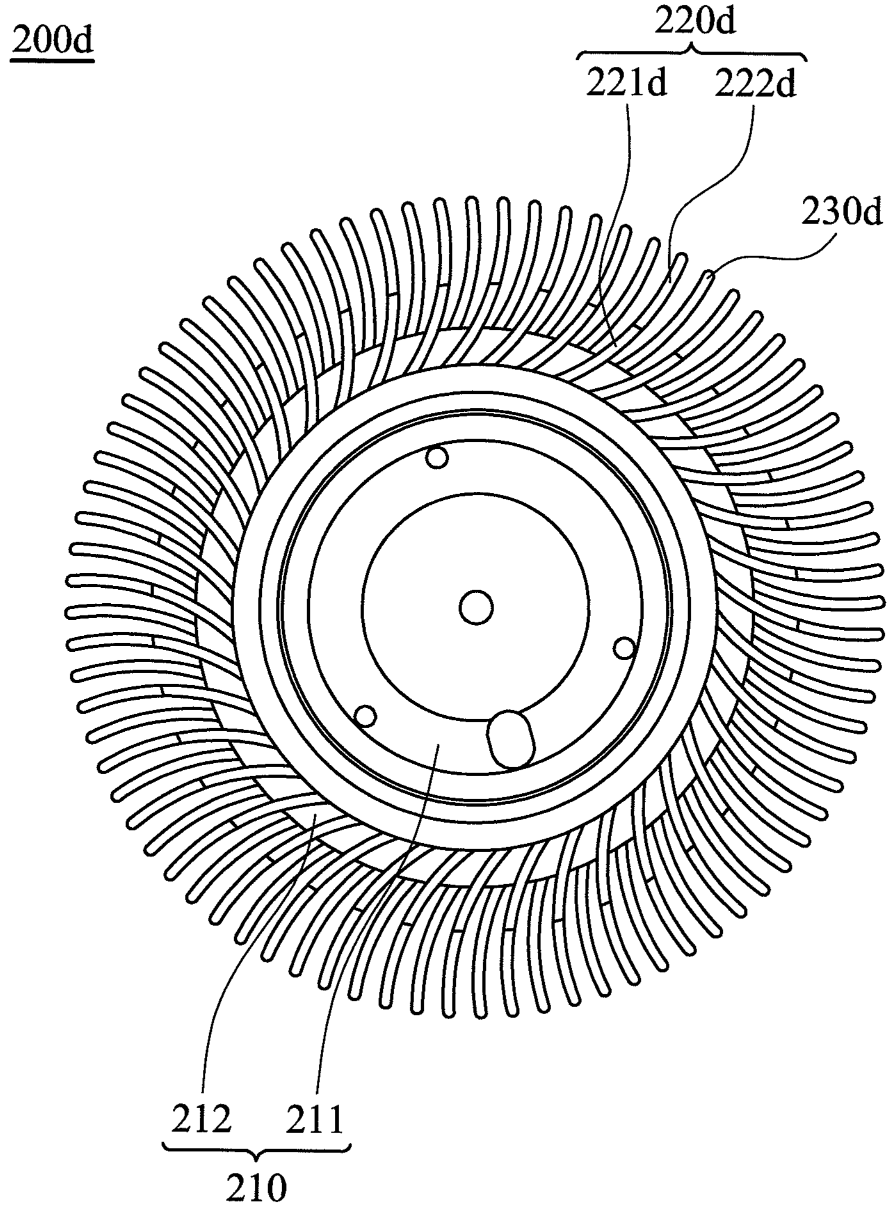


FIG. 8A

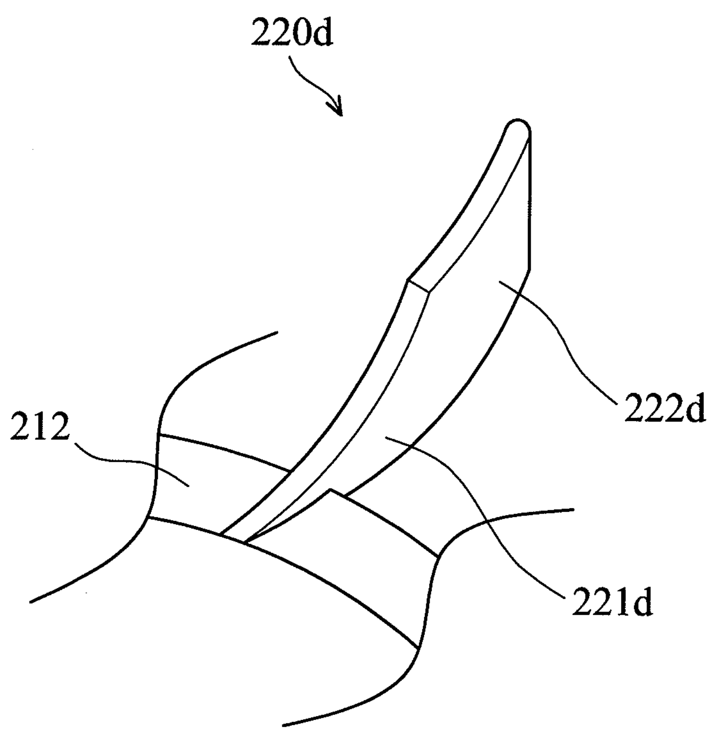


FIG. 8B

IMPELLER

CROSS REFERENCE TO RELATED APPLICATIONS

This Application claims priority of Taiwan Patent Application No. 100205780, filed on Apr. 1, 2011, the entirety of which is incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Technical Field

The invention relates to an impeller, and more particularly, the invention relates to an impeller which has two kinds of alternate blades.

2. Description of the Related Art

In a conventional electrical system, since its internal electronic element is a large heat source, and the performance of the internal electronic element degrades with the increasing of the temperature thereof, the heat generated thereby has to be quickly removed so as to keep the internal electronic element's regular performance. Therefore, a fan generating airflow is commonly used to achieve the objective of rapidly dissipating heat.

Please refer to FIGS. **1** and **2**. The conventional impeller **10** includes a hub **11** and a plurality of blades **12** circumferentially disposed around the hub **11**. When the impeller **10** rotates along a rotating direction R_1, an air-pressure is produced by the blades **12** so as to generate airflow **13** for heat dissipation.

When the performance of an electronic element is enhanced, the heat generated by the electronic element is also greatly increased accordingly. For better heat dissipation, the rotational speed of the conventional fan has to be greatly increased. However, when the rotational speed of the impeller **10** is increased, an unpleasant noise gets louder due to turbulence airflow occurring between the blades **12**.

Thus, it is a dilemma for a user. If the rotational speed is decreased, efficiency of heat dissipation degrades. If the rotational speed is increased, the noise produced by the fan becomes louder.

BRIEF SUMMARY OF THE INVENTION

In this regard, this invention provides an impeller with alternate blades, and noise produced by the impeller is remarkably reduced.

One of subjects of the invention is to provide an impeller, which includes a hub, a plurality of upper blades, and a plurality of lower blades. The hub has an upper surface and a lower surface. The upper blades are disposed around the hub and connect to the upper surface. The lower blades are disposed around the hub and connect to the lower surface. The upper and lower blades are alternately disposed and outwardly extend from the hub.

Through an arrangement of the upper and lower blades in which the upper blades and the lower blades are alternately and crowdedly disposed on the hub, turbulence airflow occurring between the blades is inhibited. Thus, noise, generated as the impeller rotates at a high speed, is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiment can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

FIG. **1** illustrates a schematic view of a conventional centrifugal fan;

FIG. **2** illustrates turbulent flow as a result of rotation of the conventional centrifugal fan;

FIG. **3**A illustrates a schematic view of the first embodiment of an impeller of the invention;

FIG. **3**B illustrates a sectional view taken from FIG. **3**A;

FIG. **3**C illustrates turbulent flow as a result of rotation of the impeller of FIG. **3**A;

FIG. **4**A illustrates a top view of the second embodiment of an impeller of the invention;

FIG. **4**B illustrates a sectional view taken from FIG. **4**A;

FIG. **4**C illustrates a schematic view of partial structures of the impeller of FIG. **4**A;

FIG. **4**D illustrates a side view of the impeller of FIG. **4**A;

FIG. **5** illustrates a schematic view of the third embodiment of an impeller of the invention;

FIG. **6**A illustrates a top view of the fourth embodiment of an impeller of the invention;

FIG. **6**B illustrates a schematic view of partial structures of the impeller of FIG. **6**A;

FIG. **7**A illustrates a top view of the fifth embodiment of an impeller of the invention;

FIG. **7**B illustrates a schematic view of partial structures of the impeller of FIG. **7**A;

FIG. **8**A illustrates a top view of the sixth embodiment of an impeller of the invention; and

FIG. **8**B illustrates a schematic view of partial structures of the impeller of FIG. **8**A.

DETAILED DESCRIPTION OF THE INVENTION

Please refer to FIGS. **3**A-**3**C. FIG. **3**A illustrates a first embodiment of an impeller **100** of the invention. FIG. **3**B illustrates a sectional view of the impeller **100**. FIG. **3**C illustrates a schematic view of partial structures of the invention, wherein only upper blades **120** and lower blades **130** and airflow **140** are shown in FIG. **3**C.

The impeller **100** includes a hub **110**, a plurality of upper blades **120**, and a plurality of lower blades **130**. The hub **110** has a circular shape and includes an upper surface **111** and a lower surface **112**, wherein a protruded mounting part **113** is formed in a substantial central portion of the hub **110**.

Each of the upper blades **120** is circumferentially disposed around the hub **110** and connects to the upper surface **111** of the hub **110**. A fixed height is maintained from a proximal end to a distal end of each of the upper blades **120**, and a cross sectional curvature of each of the upper blades **120** is not zero, wherein the term "cross sectional" is defined as a plane perpendicular to the axis C. Similarly, each of the lower blades **130** is circumferentially disposed around the hub **110** and connects to the lower surface **112** of the hub **110**. It is noted that, the upper and lower blades **120** and **130** are alternately disposed on the hub **110**. In this exemplary embodiment, the upper and lower blades **120** and **130** are alternately disposed and outwardly extend from the hub **110**. In other words, along a direction parallel to the axis C, portions of the upper and lower blades **120** and **130** are not connected with the hub **110**. Additionally, a height E_1 of the upper blades **120** is equal to a height E_2 of the lower blades **130**, but it should not be limited thereto. In the other exemplary embodiment, the height E_1 may be greater or smaller than the height E_2.

Please refer to FIG. **3**C. Due to a novel arrangement that the upper blades **120** and the lower blades **130** are alternately and crowdedly disposed on the hub **110**, as the impeller **100** rotates along a rotating direction R_2, turbulent airflow **140** is exhibited. According to experiments, a noise reduction of 3-5 dB is achieved when the impeller **100** is operated at a high speed rotation.

Please refer to FIGS. **4**A-**4**C. FIG. **4**A illustrates a top view of a second embodiment of an impeller **200** of the invention. FIG. **4**B illustrates a sectional view of the impeller **200** according to the second embodiment of the invention. FIG. **4**C illustrates a schematic view of partial structures of the impeller **200**, wherein for purpose of illustration, only an upper surface **212** of a hub **210** is shown.

The impeller **200** includes a hub **210**, a plurality of upper blades **220**, and a plurality of lower blades **230**. The hub **210** has a circular shape and includes a protruded mounting part **211**, an upper surface **212** and a lower surface **213**, as shown in FIGS. **4**A and **4**B.

The upper blades **220** are circumferentially disposed around an axis C of the hub **210** and connect to the upper surface **212** of the hub **210**. Each of the upper blades **220** has a first portion **221** and a second portion **222** coupled to the first portion **221**, wherein the first portion **221** is defined as a portion that is close to the hub **210**, and the second portion **222** is defined as a portion that is away from the hub **210**. The first portion **211** has a first thickness T_1. Further, along the outwardly extended direction of the upper blades **220**, the height of the first portion **221** is gradually increased to a height H_1. In addition, a cross section curvature of the first portion **221** is not always zero. That is, a curvature of the first portion **221** is not fixed.

The second portion **222** has the same height of the distal end of the first portion **211**, height H_1, and the thickness of the second portion **222** is not fixed, such that an airfoil is formed at each second portion **222**. Specifically, along the outwardly extended direction of the upper blades **220**, the thickness of the second portions **212** gradually increases to the thickness T_2 and then gradually decreases. Furthermore, because the airfoil formed at the second portion **222** is protruded toward to a rotation direction R_3, a length of a windward side, a side that close to the rotation direction R_3, of each of the upper blades **220** is greater than a length of a leeward side, a side that away from the rotation direction R_3, of each of the upper blades **220**.

In this exemplary embodiment, the first thickness T_1 is 0.5 mm, and the second thickness T_2 is 0.86 mm, but it is not limited thereto. The best molding techniques and material at the time of the invention can produce a blade with a thickness of 0.4 mm; thus, the ideal thickness of the upper blades **220** is between 0.4 mm and 1.2 mm. In this exemplary embodiment, the second thickness T_2 is greater than the first thickness T_1, wherein the second thickness T_2 is 1-3 times that of the first thickness T_1. Preferably, the second thickness T_2 is 1-2.5 times that of the first thickness T_1.

Please refer to FIG. **4**A. The distal ends of the first portions **221** of each of the upper blades **220** form a reference circle from a top view, and the reference circle has a radius D_r. The radius D_r of the reference circle is 0.75-0.95 times that of a radius D of the impeller **200**. Preferably, the radius D_r of the reference circle is 0.8-0.9 times that of the radius D of the impeller **200**. Additionally, the radius D_r is between a radius D_{hub} of the hub **210** and the radius D of the impeller **200**.

Because the cross section curvature of the first portion **221** is not zero, an angle A, as shown in FIG. **4**A, is formed, wherein the angle A is formed, from a top view, from the axis C to the distal end of the second portion **222** of one of the upper blades **220**, and the axis C to the proximal end of the first portion **221** of the same upper blade **220**. In this exemplary embodiment, the angle A is 11°, but it is note limited thereto. The angle A may be 0-60°, and the angle A is preferably 0-30°.

Please refer to FIGS. **4**A-**4**C and FIG. **4**D. The lower blades **230** have the same structure as the upper blades **220**. The lower blades **230** are circumferentially disposed around the hub **210** and connect to the lower surface **213** of the hub **210**, wherein the distal ends of each of the lower blades **230** has a height H_2. In this exemplary embodiment, the upper and lower blades **220** and **230** are alternately disposed and outwardly extend from the hub **210**. Furthermore, in this exemplary embodiment, a height H_1 of the upper blades **220** is greater than a height H_2 of the lower blades **230**, but it should not be limited thereto, as the height H_1 can be designed with a height that is smaller or equal to the height H_2.

Please refer to FIG. **5**. FIG. **5** illustrates a third embodiment of the impeller **200***a* of the invention. The impeller **200***a* is similar to the impeller **200**, but, the differences are that the impeller **200***a* further includes a first circular ring **240**, and the hub **210** further includes a plurality of ribs **214** and a second circular ring **215** disposed around the hub **210**. The first circular ring **240** is disposed between the upper blades **220** and the lower blades **230**, for enhanced structural strength between the upper and lower blades **220** and **230**. The ribs **214** are disposed on the outer sidewall of the mounting part **211** and radially extended. The second circular ring **215** is connected to the distal ends of each of the ribs **214**. The second circular ring **215** has an upper surface **215***a* and a lower surface **215***b*, wherein the upper blades **220** are disposed around the hub **210** and connect to the upper surface **215***a*, and the lower blades **230** are disposed around the hub **210** and connect to the lower surface **215***b*. The upper blades **220** and the lower blades **230** are alternately disposed and outwardly extend from the mounting part **211** of the hub **210**. When fabricating, the hub **210**, the upper blades **220**, the lower blades **230**, and the first circular ring **240** are formed integrally.

Structures of the upper and lower blades of the invention should not be limited by the above description. A variety of different forms of the blades will be described in the following description. For simplification, the interconnecting relationship between the blades and the hub is omitted, and descriptions of structures of lower blades of the following embodiment are omitted because the lower blades are identical with the upper blades.

Please refer to FIGS. **6**A and **6**B. FIG. **6**A illustrates a top view of an impeller **200***b*, and FIG. **6**B illustrates a schematic view of partial structures of the impeller **200***b*. To present structural features of upper blades **220***b* clearly, only an upper surface **212** of a hub **210** is illustrated. Each of the upper blades **220***b* has a first portion **221***b* and a second portion **222***b* coupled to a distal end of the first portion **221***b*. Along the extended direction of the upper blades **220***b*, the height of the first portion **221***b* is gradually increased. With the same height of the distal end of the first portion **221***b*, the second portion **222***b* extends outwardly. In this exemplary embodiment, the upper blade **220***b* extends along a radial direction with the same curvature.

Please refer to FIGS. **7**A and **7**B. FIG. **7**A illustrates the top view of an impeller **200***c*, and FIG. **7**B illustrates a schematic view of partial structures of the impeller **200***c*. To present structural features of upper blades **220***c* clearly, only an upper surface **212** of the hub **210** is illustrated. The difference between the impeller **200***b* and the impeller **200***c* is that a cross sectional curvature of a second portion **222***c* of each of the upper blades **220***c* is not zero.

Please refer to FIGS. **8**A and **8**B. FIG. **8**A illustrates the top view of an impeller **200***d*, and FIG. **8**B illustrates a schematic view of partial structures of the impeller **200***d*. To present structural features of upper blades **220***d* clearly, only an upper surface **212** of the hub **210** is shown. The difference between the impeller **200***d* and the impeller **200***b* is that cross sectional curvatures of a first portion **221***d* and a second portion **222***d* of each of the upper blades **220***d* are not zero.

As reflected above, it is thanks to the novel structure, wherein the upper and lower blades alternately and crowdedly connected to the hub, that when the impeller rotates, the turbulent airflow is exhibited, so that the problem where unpleasant noise is generated by the conventional fans is eliminated.

While the embodiment has been described by way of example and in terms of the embodiments, it is to be understood that the embodiment is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. An impeller, comprising:

a hub having an upper surface and a lower surface;

a plurality of upper blades disposed around the hub and connected to the upper surface; and

a plurality of lower blades disposed around the hub and connected to the lower surface,

wherein the upper and lower blades are alternately disposed and outwardly extend from the hub,

wherein the height of the upper and lower blades, along the extended direction, are gradually increased,

wherein a cross sectional curvature of each of the upper and lower blades is not zero, and

wherein the hub has an axis, and an angle, from a top view, formed from the axis to the distal ends of each of the upper or lower blades, respectively, and the axis to the a proximal end of each of the upper or lower blades respectively is 0-60°.

2. The impeller as claimed in claim **1**, wherein the angle is 0-30°.

3. The impeller as claimed in claim **1**, wherein each of the upper and lower blades has a first portion and a second portion, and the first portion has a first thickness, and the second portion, with an airfoil, has a second thickness, wherein the second thickness is greater than the first thickness.

4. The impeller as claimed in claim **3**, wherein the second thickness is 1-3 times that of the first thickness.

5. The impeller as claimed in claim **4**, wherein the second thickness is 1-2.5 times that of the first thickness.

6. The impeller as claimed in claim **3**, wherein a length of a windward side of each of the upper and lower blades is greater than a length of a leeward side of each of the upper and lower blades.

7. The impeller as claimed in claim **3**, wherein the distal ends of the first portions of each of the upper and lower blades form a reference circle from a top view, and a radius of the reference circle is 0.75-0.95 times that of a radius of the hub.

8. The impeller as claimed in claim **7**, wherein the radius of the reference circle is 0.8-0.9 times that of the radius of the hub.

9. The impeller as claimed in claim **1**, wherein a height of the upper blades is different from a height of the lower blades.

10. The impeller as claimed in claim **1**, wherein each of the upper and lower blades has a thickness, and the thickness is between 0.4 mm and 1.2 mm.

11. An impeller, comprising:

a hub having an upper surface and a lower surface;

a plurality of upper blades disposed around the hub and connected to the upper surface; and

a plurality of lower blades disposed around the hub and connected to the lower surface,

wherein the upper and lower blades are alternately disposed and outwardly extend from the hub, and the cross sectional curvature near to distal ends of each of the upper and lower blades is not zero.

12. The impeller as claimed in claim **11**, wherein a height of the upper blades is different from a height of the lower blades.

13. The impeller as claimed in claim **11**, wherein each of the upper and lower blades has a thickness, and the thickness is between 0.4 mm and 1.2 mm.

14. An impeller, comprising:

a hub having an upper surface and a lower surface;

a plurality of upper blades disposed around the hub and connected to the upper surface;

a plurality of lower blades disposed around the hub and connected to the lower surface; and

a first circular ring disposed between the upper and lower blades,

wherein the upper and lower blades are alternately disposed and outwardly extend from the hub.

15. The impeller as claimed in claim **14**, wherein a height of the upper blades is different from a height of the lower blades.

16. The impeller as claimed in claim **14**, wherein each of the upper and lower blades has a thickness, and the thickness is between 0.4 mm and 1.2 mm.

17. The impeller as claimed in claim **14**, further comprises a second circular ring disposed around the hub, and the upper and lower blades are connected to the second circular ring.

18. The impeller as claimed in claim **14**, wherein the hub, the first circular ring and the upper and lower blades are formed integrally as one piece.

19. An impeller, comprising:

a hub having an upper surface and a lower surface;

a plurality of upper blades disposed around the hub and connected to the upper surface; and

a plurality of lower blades disposed around the hub and connected to the lower surface,

wherein the upper and lower blades are alternately disposed and outwardly extend from the hub,

wherein the hub has an axis, and an angle, from a top view, formed from the axis to the distal ends of each of the upper or lower blades, respectively, and the axis to the a proximal end of each of the upper or lower blades, respectively, is 0-60°.

20. The impeller as claimed in claim **19**, wherein each of the upper and lower blades has a first portion and a second portion, and the first portion has a first thickness, and the second portion, with an airfoil, has a second thickness, wherein the second thickness is greater than the first thickness.

21. The impeller as claimed in claim **20**, wherein the second thickness is 1-3 times that of the first thickness.

22. The impeller as claimed in claim **21**, wherein the second thickness is 1-2.5 times that of the first thickness.

23. The impeller as claimed in claim **20**, wherein a length of a windward side of each of the upper and lower blades is greater than a length of a leeward side of each of the upper and lower blades.

24. The impeller as claimed in claim **20**, wherein the distal ends of the first portions of each of the upper and lower blades form a reference circle from a top view, and a radius of the reference circle is 0.75-0.95 times that of a radius of the hub.

25. The impeller as claimed in claim **24**, wherein the radius of the reference circle is 0.8-0.9 times that of the radius of the hub.

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